Preface and Acknowledgments

A few years back, I was sitting in the cafeteria of the Google headquarters with longtime friend Alexander "Andy" Karsner. He suggested I needed a change. We kicked some ideas around. I said I would like to write a book. We both felt at the time that Silicon Valley was on a collision course with the Texas oil industry and that neither knew enough about the other to make sensible future investment decisions on new energy technologies. Andy and I had organized an academic retreat for leaders from both sectors at an inn in Napa Valley. Each side was shocked and amazed to hear what the other was doing. Afterward, Royal Dutch Shell pursued a joint venture with one of the hydrogen firms in attendance. Other companies pursued relationships with big-data providers. It was as though two meteors had collided, and neither could go right back onto its old trajectory.

Andy has guided my education on the intersection of tech, energy, and climate change for several years now. To get this book off the ground, we organized a study group of business leaders, leading academics, and policy makers on the "Tech Enabled Energy Future" as part of my work at the Council on Foreign Relations. The study group greatly expanded my knowledge, facilitating the contents of this book. I am grateful to the study group for its dedication to the purpose of open-minded learning and to the companies that hosted us on our Silicon Valley tour, including Applied Materials, Google X, and Carbon 3D. My thank-you on the study group exercise would not be complete without mentioning Evan Michelson and the Alfred P. Sloan Foundation, which generously supported the study group, this research, and my other research over multiple years and three academic institutions. Nicole Alexiev and Shelbi Sturgess provided organizational muscle to the study group endeavor while my research associates

Dylan Yalbir and Ben Silliman provided important research contributions, as did my fantastic summer intern, Stefan Koester. I also thank Lucy Best and Michael Collins for their outstanding research contributions on China's energy strategy and Liz Economy and Steven Lewis for their expert counsel on China's unique internal politics.

I want to thank the Council on Foreign Relations for the opportunity to work on a book project. I also thank Caelyn Cobb, my editor at Columbia University Press, for her steady guidance and Patricia Dorff, who spent countless hours advising and encouraging me during the drafting process. I offer a special thanks to my research associate Gabi Hasaj, whose intervention on the challenge of completing a manuscript in the middle of a pandemic was invaluable.

I also owe special thanks to friends and mentors who have played a guiding role in the process of researching and writing. It is only fitting that Edward Morse, my longtime mentor and friend, was the first person to read the manuscript and give treasured advice. Jason Bordoff, director of the Center on Global Energy Policy at Columbia University and an enthusiastic friend and supporter, also provided much appreciated encouragement for the book project and a frequent forum at Columbia to try out my new ideas regarding tech and peak oil demand. My dear friend Alison Cowan was instrumental in guiding me into the excitement of sleuthing the mysteries of the Edison-Ford partnership on an electric vehicle and other archival treasure hunts, and we are both indebted to Paul Israel, director and general editor of the Thomas A. Edison papers project and research professor at Rutgers University.

Several of my academic research collaborators offered significant research contributions to the book, notably including Lew Fulton, Daniel Scheitrum, and Zane McDonald for their intrepid persistence to our joint modeling on peak oil demand. Other important research collaborators include Kelly Sims Gallagher, Paul Griffin, Joan Ogden, Mahmoud El-Gamal, Likeleli Seitlheko, Hany Abdel-Latif, Marianne Kah, Rosa Dominguez-Faus, and Nathan Parker. Steve Currall and Jagdeep Bachher gave me the time and platform to pursue my interest in the intersection of sustainability, climate change, and finance and helped me think outside the box on what the future might bring. Their insights were supplemented by my ongoing discussions with Joe Barnes, Rene Aninao, Andrew Lebow, Matt Rogers, Jareer Elass, and Albert Lee.

I learned most of what I know about energy markets from the trenches, starting when I was a young journalist and continuing today. Many smart and

generous people from the international policy world, from the energy industry, and from Silicon Valley took the time, and still take the time, to help me understand complex issues. I definitely need to thank them for my success, but so many talked to me on the basis of anonymity that I offer this blanket acknowledgment. You know who you are; know that I greatly appreciate your time and assistance. Ditto my original team at *Petroleum Intelligence Weekly*, with a special shout-out to Ira Joseph, Isabel Gorst, and the late Alan Troner.

Often people ask me how I became an energy economist with no formal PhD educational training. In actuality, that is only technically correct in terms of conferred degrees. In terms of hours spent learning economics with a dissertation adviser, my many joint publications with Ronald Soligo could constitute a lengthy tutorial. He was a patient, able instructor. The fact that both Kenneth Medlock and I have prizes in economics is no coincidence. Besides our own incredibly fruitful collaboration with each other, we were both lucky students of Soligo.

Throughout my work in energy and geopolitics, many luminaries have helped make my journey a successful one. In the sciences, Neal Lane, the late Richard Smalley, Daniel Sperling, and Robert Powell were able mentors. Ambassador Edward Djerejian, the director of the James A. Baker III Institute for Public Policy, taught me valuable lessons on the power of storytelling in public diplomacy and the art of negotiation.

Then there is the shining beacon of my career, Secretary James A. Baker III, who showed me by example so many lessons for my life I could write a book on the subject. Most important, he showed me the value of not speaking or acting in haste. His invaluable instruction in the art of patience greatly contributed to this book and to my life.

And to the shrewdest human being I know, Dr. Falih Al-Jibury, who sat with me for countless hours in the hotel lobby during the meetings of the Organization of Petroleum Exporting Countries and imparted much wisdom on international relations, I owe you a debt of gratitude.

Finally, here is where I get to say in writing that I fully understand that if I had married someone else, my life would have been a duller and less fruitful endeavor. An inveterate self-starter, my husband Rick Jaffe has been the rock from which all my incredible forays, including this book, have sprung forth. I would also like to add that this book would not have been possible without countless hours with my beloved Rebecca listening to my complaints, correcting any faulty

understanding of electricity markets and storage systems, and sharing a laugh. I thank Jordan for his quiet presence, without which writing a book might have been a harder challenge. And to Daniel, with whom I check all ideas, energy and otherwise, your wise counsel has improved my life and this book invaluably. "Nothing gold can stay," to quote Robert Frost, but love of family is eternal.

Finally, in addition to my family, I feel it is important to dedicate this book to Richard Smalley. He believed that the single greatest challenge humanity faced was meeting the world's burgeoning energy needs with clean, renewable energy. "If you believe with me that we absolutely need to provide the planet's 10 billion people with the potential to pursue a fulfilling lifestyle, where they have a roof over their heads, enough food to eat, sufficient mobility, communications, and the capability to build homes and develop cities," he proffered, "then, you will agree that we have to revolutionize the world's energy system. We need cheap, clean energy in vast amounts"—an effort he came to name the Terrawatt Challenge.[1] Smalley's vision was that electricity should become the ubiquitous fuel of the twenty-first century, based on a decentralized, local energy storage model where everyone on the grid would have a personal storage appliance that could ensure delivery of uninterrupted power. This distributed system would be supplemented by rewiring the electric grid with superconductors that could enable cross-continent and even worldwide electrical transmission, taking advantage of time zones, climate variations, and large-scale sources of power such as nuclear energy. Smalley was ahead of his time. A sample of the system he envisioned was built by Tesla in South Australia in 2017.

Richard Smalley hoped, in his final years, that he would inspire a future Einstein of energy, up for the challenges of tomorrow. This book is my own attempt to spread the word and encourage others to be part of the solution, exploring or harnessing new technologies to achieve the highest possible outcome for our planet. Richard Smalley's vision of distributed electricity and small-scale battery storage is just the tip of the iceberg of the impact digital innovation will have on how we produce and use energy.

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I put the finishing touches on this book in the midst of the unprecedented lockdown of the United States and other major economies in light of the COVID-19 pandemic and then, no less important, amid historic protests related to social

injustice. This is not a book about those events, the consequences of which will take years to unfold. But both those historic turning points draw attention to the pressing challenges we face both in addressing climate change and in bringing affordable, reliable energy equally to all segments of society. Without access to energy, other vital needs like clean water, food security, and health care become nearly impossible.

I am technocentric, not Malthusian. I believe there is a generation of new energy scientists, engineers, policy analysts, economists, and political activists who are well placed to push for the changes needed and to succeed, especially because of the opportunities that digital energy can create. This book is aimed to provide some context, if not inspiration, for their work.

So much is in flux that one must keep an open mind that the future can be one of positive change. History is a teacher in this regard. Progress often comes in the wake of destruction of old ideas, landscapes, and institutions. For the digital energy revolution, as the coming pages will explain, many of the long-standing principles around which the energy sector was organized will see their demise.